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What is Claimed:

- 1 1. A method for substantially maintaining a dispersion penalty of an
2 uncooled optical transmitter within a predetermined temperature range, the uncooled
3 optical transmitter including a laser and an electroabsorption modulator (EAM), the
4 method comprising the steps of:
 - 5 a) determining small signal α crossing points at two temperatures within
6 the predetermined temperature range;
 - 7 b) calculating an EAM bias voltage versus temperature control function
8 based on the two small signal α crossing points determined in step (a); and
 - 9 c) adjusting the bias voltage of the EAM based on the EAM bias voltage
10 versus temperature control function determined in step (b) to substantially maintain the
11 dispersion penalty of the uncooled optical transmitter within the predetermined
12 temperature range.
- 1 2. The method according to claim 1 wherein the EAM bias voltage
2 versus temperature control function determined in step (b) is linear.
- 1 3. The method according to claim 1 wherein the maintained dispersion
2 penalty of the uncooled optical transmitter is less than 2dB for 1600ps/nm data
3 transmission at 10Gb/s.
- 1 4. A method for substantially maintaining a dispersion penalty of an
2 uncooled optical transmitter within a predetermined temperature range, the uncooled
3 optical transmitter including a laser and an electroabsorption modulator (EAM) formed
4 using a selected material system, the method comprising the steps of:
 - 5 a) determining small signal α crossing points a lowest temperature of
6 the predetermined temperature range;

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7 b) calculating an EAM bias voltage versus temperature control function
8 based on the small signal α crossing points determined in step (a) and a predetermined
9 slope, the predetermined slope based on the selected material system; and

10 c) adjusting the bias voltage of the EAM based on the EAM bias voltage
11 versus temperature control function determined in step (b) to substantially maintain the
12 dispersion penalty of the uncooled optical transmitter within the predetermined
13 temperature range.

1 5. The method according to claim 4 wherein the EAM bias voltage
2 versus temperature control function determined in step (b) is linear.

1 6. The method according to claim 4 wherein the maintained dispersion
2 penalty of the uncooled optical transmitter is less than 2dB for 1600ps/nm data
3 transmission at 10Gb/s.

1 7. An uncooled long reach optical transmitter, comprising;

2 an uncooled laser source to produce a laser beam;

3 an uncooled semiconductor optical amplifier (SOA) optically coupled to the
4 uncooled laser source to amplify the laser beam; and

5 an uncooled electroabsorption modulator (EAM) optically coupled to the
6 uncooled SOA to modulate the amplified laser beam.

1 8. The uncooled long reach optical transmitter according to claim 7,
2 further comprising an optical isolator located between the uncooled laser source and the
3 uncooled SOA to substantially reduce optical feedback of the laser beam into the uncooled
4 laser source.

1 9. The uncooled long reach optical transmitter according to claim 7,
2 wherein the uncooled laser source and the uncooled SOA are monolithically integrated.

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1 10. The uncooled long reach optical transmitter according to claim 9,
2 further comprising an optical isolator located between the uncooled SOA and the uncooled
3 EAM to substantially reduce optical feedback of the amplified laser beam into the uncooled
4 laser source.

1 11. The uncooled long reach optical transmitter according to claim 7,
2 wherein the uncooled SOA and the uncooled EAM are monolithically integrated.

1 12. The uncooled long reach optical transmitter according to claim 7,
2 wherein the uncooled laser source, the uncooled SOA, and the uncooled EAM are
3 monolithically integrated.

1 13. The uncooled long reach optical transmitter according to claim 12,
2 further comprising an optical isolator configured to receive the modulated laser beam to
3 substantially reduce optical feedback of the modulated laser beam into the uncooled laser
4 source.

1 14. The uncooled long reach optical transmitter according to claim 7,
2 further comprising an optical power detector optically coupled to the uncooled EAM to
3 monitor output power of the modulated laser beam.

1 15. The uncooled long reach optical transmitter according to claim 7,
2 further comprising a temperature insensitive wavelength detector optically coupled to the
3 uncooled EAM to monitor a peak output wavelength of the modulated laser beam.

1 16. An uncooled long reach optical transponder, comprising;

2 a PIN photodiode receiver;

3 modulation circuitry electrically coupled to the PIN photodiode receiver and
4 adapted to provide a modulation signal responsive to an incident optical signal which is
5 incident on the PIN photodiode receiver;

6 an uncooled laser source to produce a laser beam;

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an uncooled semiconductor optical amplifier (SOA) optically coupled to the uncooled laser source to amplify the laser beam; and

an uncooled electroabsorption modulator (EAM) optically coupled to the SOA and electrically coupled to the modulation circuitry;

wherein the uncooled EAM modulates the amplified laser beam in response to the modulation signal to form an output optical signal of the uncooled long reach optical transponder.

17. A method for substantially maintaining an output power of an uncooled optical transmitter within a predetermined temperature range, the uncooled optical transmitter including a laser and a semiconductor optical amplifier (SOA), the method comprising the steps of:

a) setting an initial laser bias current of the laser and an initial SOA bias current of the SOA;

b) measuring the output power of the uncooled optical transmitter; and

c) adjusting the SOA bias current based on the output power measured in step (b) to substantially maintain the output power of the uncooled optical transmitter.

18. A method for improving transmitter reliability of an uncooled long reach optical transmitter operating substantially at a predetermined output power, the uncooled long reach optical transmitter including a laser and a semiconductor optical amplifier (SOA), the method comprising the steps of:

a) operating the laser to produce a reduced power laser beam, thereby improving laser reliability of the laser; and

b) controlling an SOA bias current to amplify the reduced power laser beam in the SOA and substantially maintain the predetermined output power;

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9 wherein the SOA is sufficiently long to provide the amplification of step (b)
10 and maintain a reduced current density within the SOA, thereby improving SOA reliability
11 of the SOA.

1 19. A method according to claim 18 wherein the uncooled long reach
2 optical transmitter further includes an electroabsorption modulator (EAM), and the method
3 further comprises the step of:

4 c) controlling an EAM bias voltage to substantially maintain a
5 substantially constant dispersion penalty of the uncooled optical transmitter.

1 20. A method for manufacturing a monolithic laser integrated module for
2 use in an uncooled long reach optical transmitter, the method comprising the steps of:

3 a) providing a substrate base having a substrate base index of
4 refraction;

5 b) forming a grating layer over the substrate base, the grating layer
6 having a grating index of refraction different from the substrate base index of refraction;

7 c) defining and etching the grating layer to form a grating base section
8 having a grating period;

9 d) forming a top substrate layer over the substrate base and the grating
10 base sections, the top substrate layer having a substrate index of refraction different from
11 the grating index of refraction and a top surface;

12 e) forming a quantum well layer on the top surface of top substrate
13 layer having a waveguide index of refraction different from the substrate index of
14 refraction and including a plurality of sub-layers forming a quantum well structure, each of
15 the sub-layers including a waveguide material;

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- 16 f) forming a semiconductor layer on the quantum well layer, the
17 semiconductor layer having a semiconductor layer index of refraction different from the
18 waveguide index of refraction;
- 19 g) defining and etching the quantum well layer and the semiconductor
20 layer to form a distributed feedback laser section, a semiconductor optical amplifier (SOA)
21 section, and an electroabsorption modulator (EAM) section in the quantum well layer;
- 22 h) depositing a distributed feedback laser electrode on the
23 semiconductor layer corresponding to a portion of the distributed feedback laser section of
24 the quantum well layer;
- 25 i) depositing an SOA electrode on the semiconductor layer
26 corresponding to a portion of the SOA section of the quantum well layer; and
- 27 j) depositing an EAM electrode on the semiconductor layer
28 corresponding to the EAM section of the quantum well layer.

1 21. A method according to claim 20, wherein step (e) includes the steps
2 of:

- 3 e1) forming at least one patterned growth retarding mask on a laser area
4 and an SOA area of the top surface of the top substrate layer; and
- 5 e2) forming the quantum well layer on the top surface of the top
6 substrate layer by selective area growth, the quantum well layer including;
- 7 a laser portion formed over at least the grating base section and
8 adjacent to the laser area of the top surface of the top substrate layer, the laser
9 portion having a laser thickness;
- 10 an SOA portion formed adjacent to the SOA area of the top surface of
11 the top substrate layer, the SOA having a SOA thickness; and

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12 an EAM portion having an EAM thickness which is less than the laser
13 thickness and the SOA thickness.

1 22. A method according to claim 20, wherein the sub-layers of the
2 quantum well layer include at least one of strained InGaAlAs sub-layers and graded
3 InGaAlAs sub-layers.

1 23. A method according to claim 20, wherein:

2 steps b, d, e, and f use metal organic chemical vapor deposition (MOCVD);
3 and

4 step c uses at least one of phase mask lithography and anisotropic etching.